



When is “FAIR” F.A.I.R.?

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“We’ve been FAIR
since before there
was a FAIR.”

HMM...



Open and
F.A.I.R are *not*
the same thing.



“OPEN” IS ABOUT DATA
RIGHTS AND LICENSING.
“F.A.I.R.” IS ABOUT
MECHANICS.

“FAIR” is primarily
concerned with
programmatic
processing.

FAIR RECOGNIZES THAT DATA
IS DIVERSE AND SCATTERED
ACROSS CYBERSPACE.
SOFTWARE PROCESSING
LEVELS THE PLAYING FIELD.

The FAIR Principles at go-fair.org



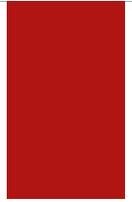
“F.A.I.R” is not a
binary state.

FAIRNESS IS A SPECTRUM.
THERE ARE VARIOUS WAYS
TO INCREASE FAIRNESS AND
THEY CAN BE APPLIED
INCREMENTALLY.

The FAIR Principles at go-fair.org



“We’ve been FAIR
since before there
was a FAIR.”



Findability

If a user must know which specific archive's service to query to search for a data resource, the data are not *Findable*.

First Steps:

- ▶ Assign DOIs to data resources.
- ▶ Provide rich metadata in the DOI record.
- ▶ Include tagged metadata (schema.org, for example) on the landing page for the data resource.



Accessibility

If the globally unique identifier (the DOI, e.g.) cannot be used to fetch the metadata for the data resource from the repository interface, the (meta)data are not *Accessible*.

First Steps:

- ▶ Implement a DOI retrieval option in the local interface.
- ▶ If the only interface(s) requires human interaction, prioritize API development.



Interoperability

If a human must read a document to find or understand the metadata, the data are not *Interoperable*.

First Steps:

- ▶ Provide metadata in machine-readable formats.
- ▶ Use standard vocabularies defined by recognized authorities that are programmatically actionable (UAT keywords, for example) wherever possible.



Reusability

If the metadata for the resource do not indicate the copyright holder and license, the data are not *Reusable*.

First Steps:

- ▶ If the data are known to be in the worldwide public domain, indicate that clearly in the metadata.
- ▶ Provide *both* copyright holder and license in programmatically accessible metadata otherwise.
- ▶ Use standard digital licenses (CC licenses, e.g.) with formal references.

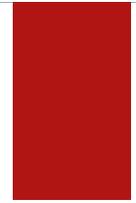


Take-aways

- ▶ Open is good. FAIR is good. Open *and* FAIR is the goal.
- ▶ Increasing FAIRness can and should be an ongoing process.
- ▶ Do the easy things first.
- ▶ Seek assistance and support for the hard things.



Questions?



The FAIR Principles at go-fair.org





What is FAIR?

An evolving NASA view

12 July 2023

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NASA Chief Science Data Office



Why do we care about FAIR?

- NASA Science Information Policy (SPD-41a) says data should be FAIR.
- The principles have helped to focus conversation. It's a great foundation.
- It's a clever acronym. Perhaps too clever by half.

What is FAIR?

- 15 principles focussed on what machines (not humans) need at a base level to ensure the broad objectives of FAIR can be achieved.
- Of course we must consider human concerns, but that is not the focus of the principles. They provide a technical baseline that allows us to commonly work at a higher level of abstraction.

The 15 Principles

- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource
- A1. (meta)data are retrievable by their identifier using a standardized communications protocol
 - A1.1 the protocol is open, free, and universally implementable
 - A1.2 the protocol allows for an authentication and authorization procedure, where necessary
- A2. metadata are accessible, even when the data are no longer available
- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles
- I3. (meta)data include qualified references to other (meta)data
- R1. meta(data) are richly described with a plurality of accurate and relevant attributes
 - R1.1. (meta)data are released with a clear and accessible data usage license
 - R1.2. (meta)data are associated with detailed provenance
 - R1.3. (meta)data meet domain-relevant community standards

What do we know about FAIR?

- A survey of NASA Scientific Data Repositories (see more detailed summary)
 - 16 of 34 repositories responded (47% response rate):
 - 4 Planetary, 1 heliophysics, 6 Astrophysics, 3 Earth Science, 2 Bio
 - More responses still welcome
- All respondents are working on FAIR
- Large variability in what that means and costs
- Most use their own assessment or process
 - GeneLab uses FAIR Evaluator and the GO FAIR Foundation Qualification.
 - LSDA (not an SMD repo) uses FAIR Data Point and FAIR Evaluator.
 - The Astromaterials Data System uses FAIR Implementation Profiles within a custom process.
- Many use existing community standards and assume that does the trick, e.g. IVOA, UMM, PDS, TRUST, Core Trust Seal ...

What do we know about FAIR?

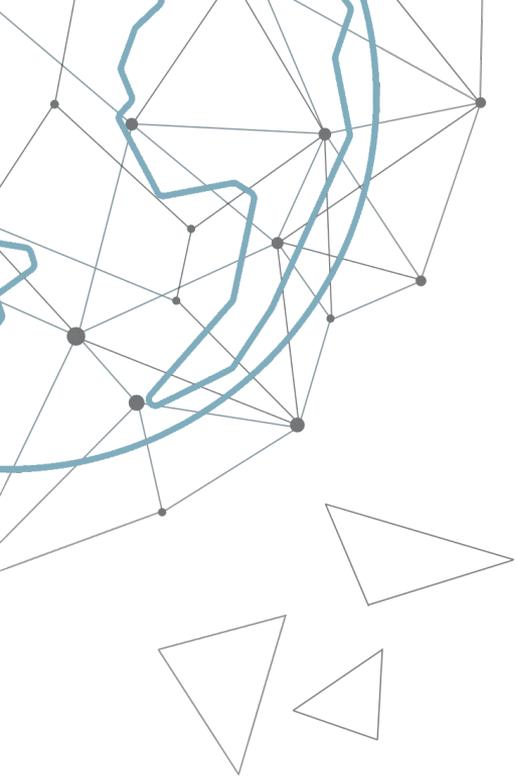
- **Persistent Identifiers** an active area but variable adoption: 7 have PIDS on all data, 4 have PIDs on more than half, and 5 have PIDS on less than half to none.
- **Rich metadata:** All but one have defined metadata standards. Those for Earth Science and PDS seem the most comprehensive. Compliance with the standards and general “richness” is uncertain, but much NASA data is very richly described at least for humans.
- **Licenses:** NASA data are generally very openly accessible. All the repositories have at least human readable usage guidance, several have machine-readable licenses, and many allow programmatic access through an API.

What do we know about FAIR?

- **User engagement:** Most of the repositories have user working groups and help desks. They also attend relevant conferences and solicit general feedback. Several repositories conduct user surveys. Of particular note is the ACSI (American Customer Satisfaction Index) survey conducted annually by the Earth Science DAACs.

Challenges

- Resource constraints, especially specialized resources.
- Legacy data (Levels of service?)
- Provider compliance with standards and guidelines
- Tracking data use and citation (Make Data Count?)
- Lack of standards for I and R, especially semantics, especially challenging for specialized data
- FAIR data in the cloud



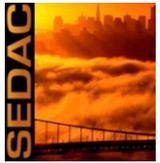
Thank You

Contact me at mark.parsons@uah.com @chutneyboy



COLUMBIA CLIMATE SCHOOL
CENTER FOR INTERNATIONAL EARTH SCIENCE
INFORMATION NETWORK

THE UNIVERSITY OF
ALABAMA IN HUNTSVILLE



Development of FAIR Guidance in the Earth Sciences Division

Robert R. Downs¹ and Ge Peng²

¹NASA Socioeconomic Data and Applications Center (SEDAC)

ESDIS Standards Coordination Office (ESCO)

Center for International Earth Science Information Network (CIESIN)

Columbia Climate School, Columbia University

²Earth System Science Center/NASA MSFC IMPACT

University of Alabama in Huntsville

Prepared for Presentation to

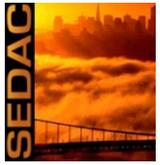
Enabling FAIR Data at NASA — A Planning Webinar

13 July 2023, 12:00 - 1:00 p.m. EDT





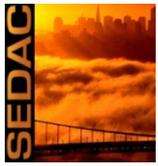
OFAIR WG – Synopsis



- Recognizing the need to continually improve practices for data management, stewardship, and distribution, the NASA ESDSWG on Making NASA SMD Data Open, Free, Findable, Accessible, Interoperable, and Reusable (O'FAIR) is establishing guidance for data producers and distributors to enable the use of NASA Earth science data as open and FAIR



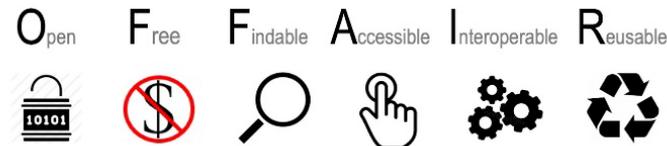
OFAIR WG – Establishment



- ESDSWG 2022 Meeting participants proposed the Earth Science Data System Working Group (ESDSWG) on Making NASA SMD-funded Earth Science Data Open, Free and FAIR (O'FAIR WG)



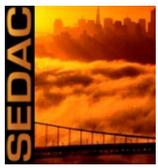
- Objective: The O'FAIR Working Group aims to synthesize community FAIR practices to provide principle-by-principle guidance on how to apply existing practices to ensure or enable NASA SMD-funded Earth science open and free data/information are also findable, accessible, interoperable, and (re)usable.

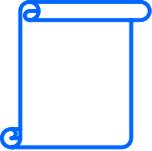


- Technical Chairs: Ge Peng and Robert R. Downs
- ESDS/ESDIS POC: Francis Lindsay



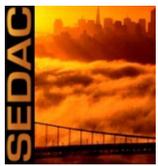
OFAIR WG – General Approach



- Define the scope and targeted audience by examining SPD-41a, FAIR Guiding Principles, and related information
- Explore and identify gaps, recommended practices and improvements by reviewing FAIR, data management and stewardship practices, adoption of standards, and FAIR assessments at NASA and across national and international research data communities 
- Produce an inception report and draft the guide document by synthesizing international and NASA FAIR practices, obtaining consensus and documenting existing practices and assessments
- Develop and produce guide document and submit to ESDSWG as the WG outcome and to ESCO for review and publication 



OFAIR WG – Key Activities

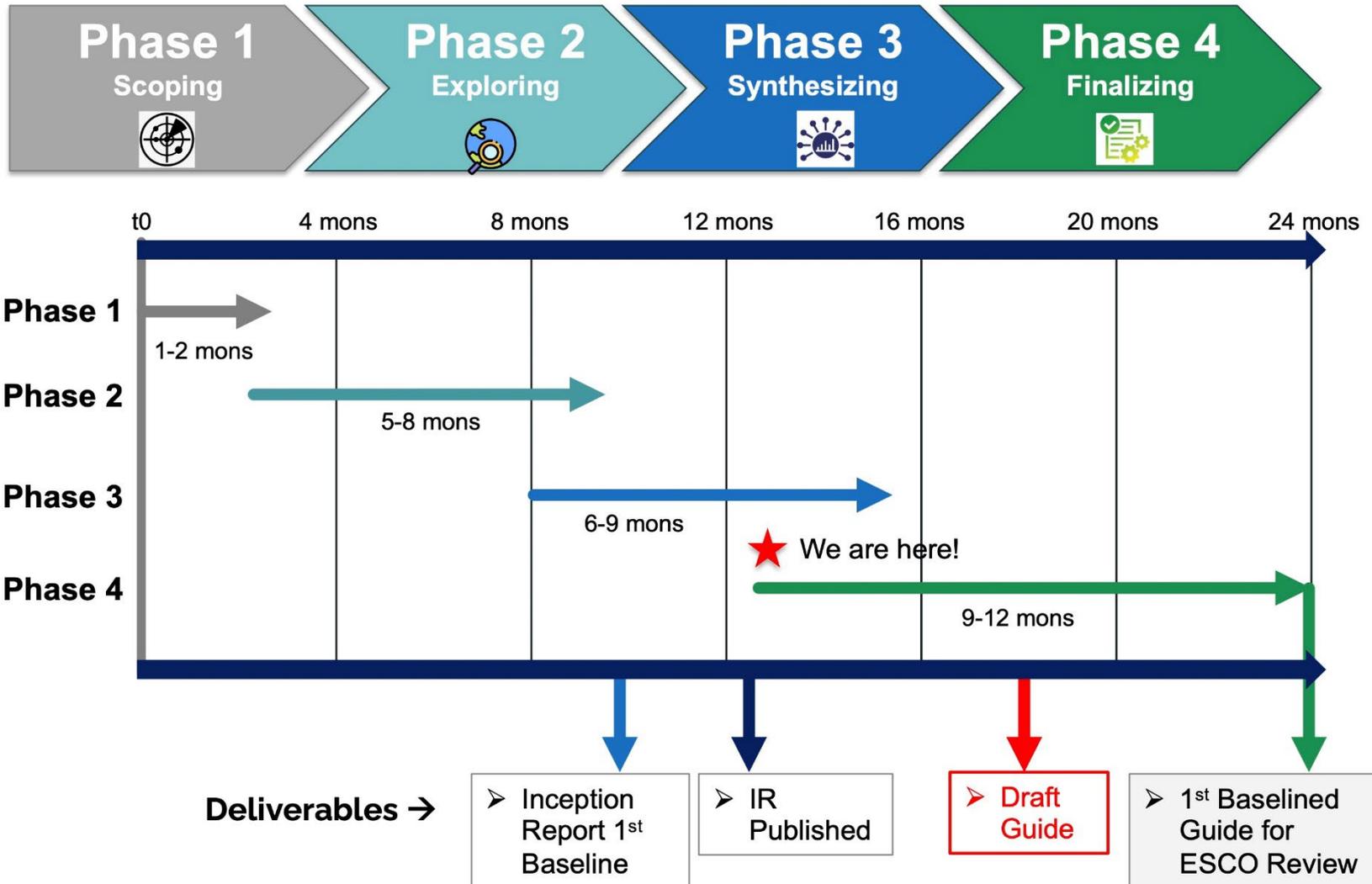
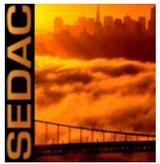


- Inaugural meeting
 - Identification of contributors and interests
- Monthly telecons - Invited presentations and discussions
 - SPD-41a. Steve Crawford, SMD Science Data Officer
 - FAIR US. Melissa Cragin, SDSC,UCSD; Rice University
 - Enhancing Atmospheric Composition Data FAIRness. Gao Chen, ASDC
- FAIR Practices Collection Spreadsheet
 - Resources on FAIR adoption practices
- In-person break-out meeting at ESDSWG Annual Meeting
 - Discussion on scope and contents of guide document
- First WG deliverable: Inception Report released
 - high-level overview of community FAIR practices



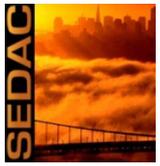


O'FAIR WG – Current Status





O'FAIR WG – Inception Report

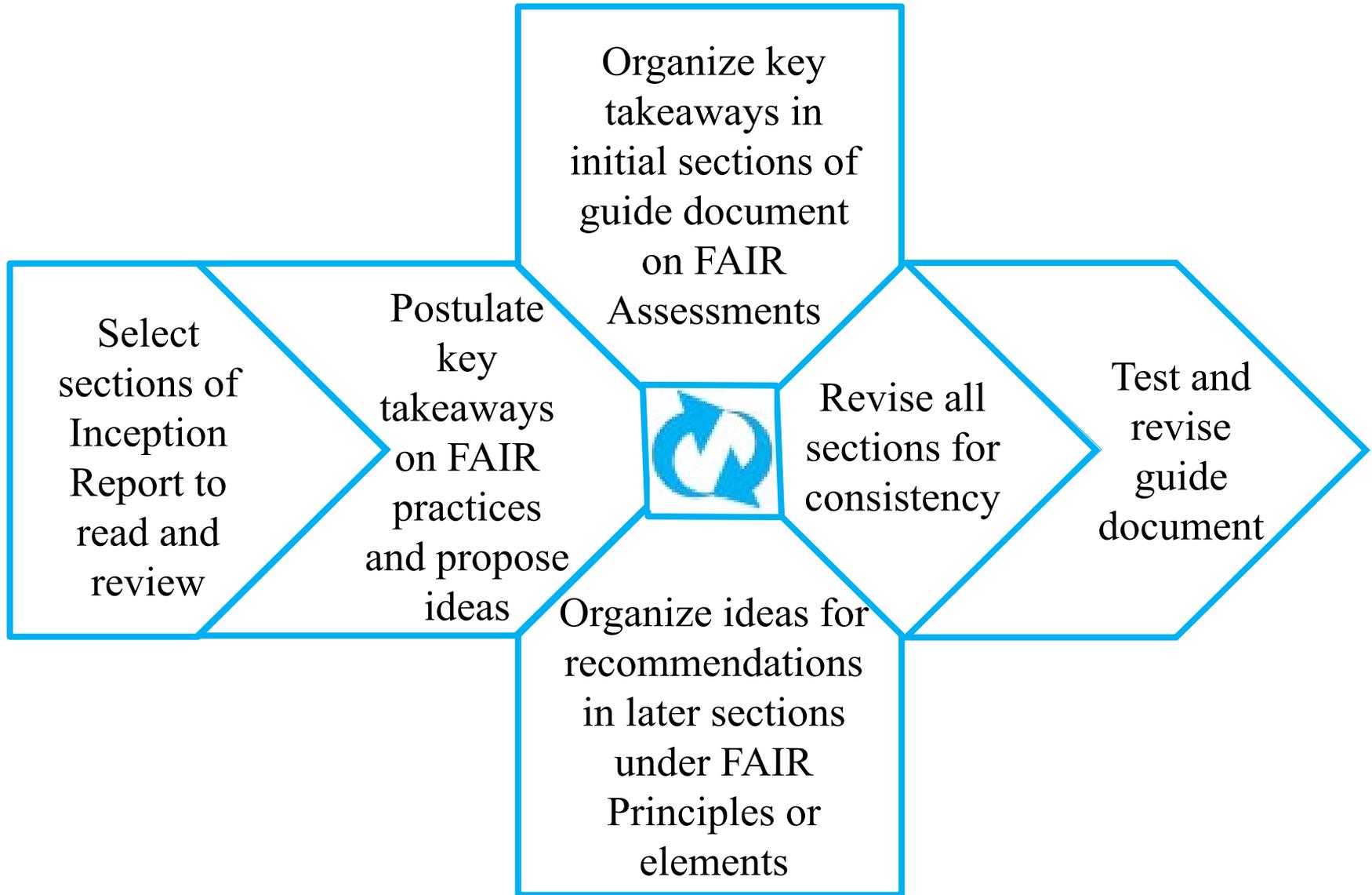
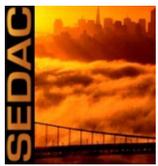


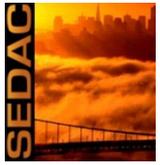
- Reviews application of FAIR Principles and provides an overview of FAIR for Earth science data
- Published publicly via the ESDIS Standards Coordination Office (ESCO)
 - Peng, et al. 2023. An Overview of Community FAIR Practices – NASA O'FAIR WG Inception Report. Document ID: NASA-OFAIR-ESDSWG-DOC-0001. Version: v01r00-20230508.
<https://doi.org/10.5067/DOC/ESCO/ESDSWG-0001V1>





OFAIR WG – Guide Development

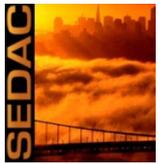




A PRACTICAL GUIDE

1. EXECUTIVE SUMMARY
 2. INTRODUCTION
 3. BACKGROUND
 4. FAIR PRINCIPLES, SPD-41a, AND OTHER PRINCIPLES
 5. STATE OF THE ART IN FAIR-NESS ASSESSMENT
 6. CURRENT STATE OF FAIR-NESS ASSESSMENT OF NASA'S EARTH SCIENCE DATA
 7. MAKING NASA EARTH SCIENCE DATA FAIR
 8. DISCUSSION
 9. CONCLUSION
 10. ACKNOWLEDGEMENT
 11. REFERENCES
- APPENDIX A. TERMS AND DEFINITIONS





Thank you!

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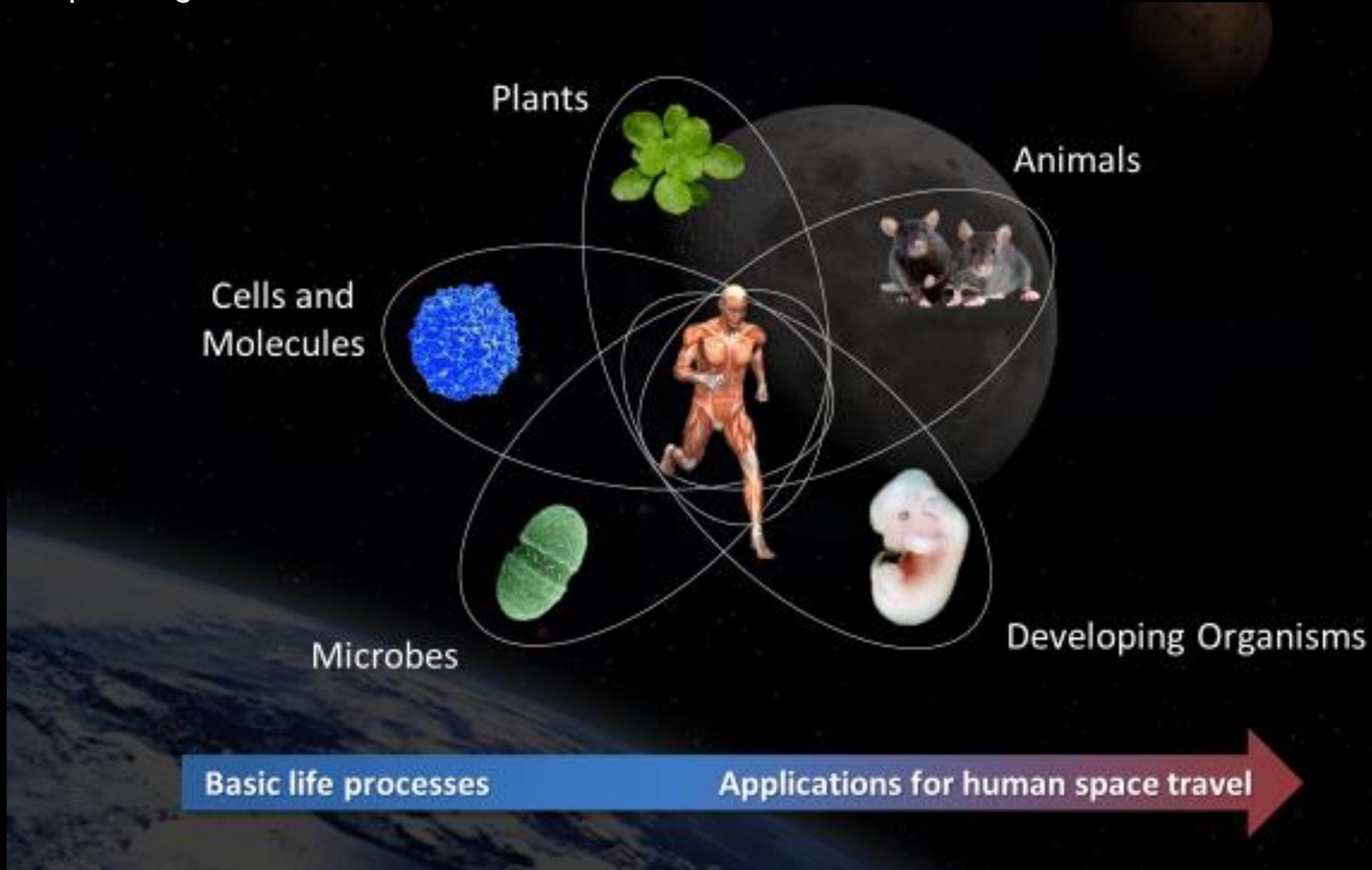
ge.peng@uah.edu

Implementation of FAIR in the life sciences



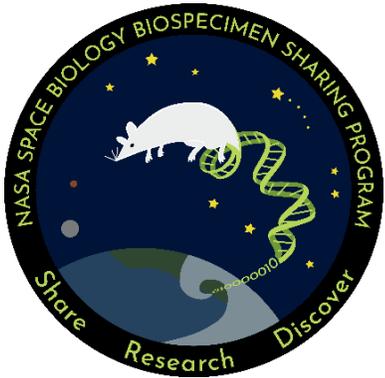
Samrawit Gebre
GeneLab Deputy Project Manager
NBISC Project Manager
NASA Ames Research Center

Space Biology Program: conducts research to use the space environment to advance our knowledge of how gravity affects the design and function of living organisms, and to understand how biological systems accommodate to spaceflight environments



NASA Biological Open Science Resources

Biospecimen Sharing Program (BSP)

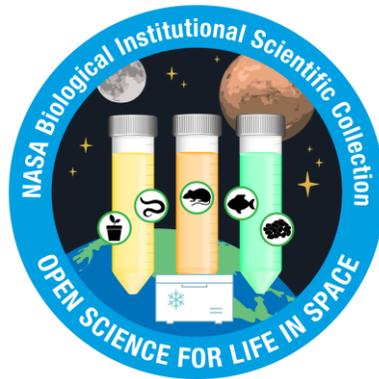


Dissection and preservation of rodent tissues from Flight and Ground investigations. Coordination of internal tissue sharing

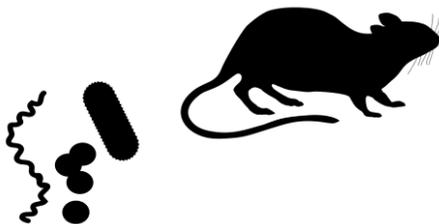


NASA Internal Program

NASA Biological Institutional Scientific Collection (NBISC)



Collection of non-human specimens and space microbial culture

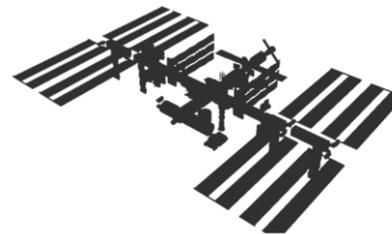


Open Source Science Programs – Available Globally

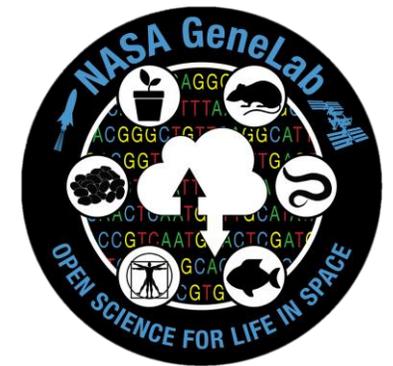
Ames Life Sciences Data Archive (ALSDA)



Collection and curation of mission, project, and imaging data



NASA GeneLab (GL)

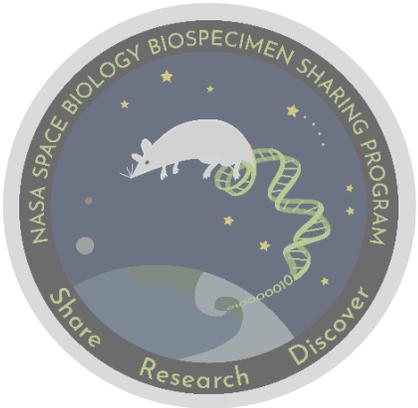


Collection and curation of omics data



NASA Biological Open Science Resources

Biospecimen Sharing Program (BSP)



Dissection and preservation of rodent tissues from Flight and Ground investigations. Coordination of internal tissue sharing

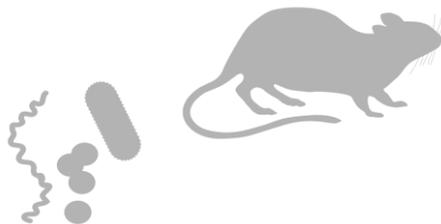


NASA Internal Program

NASA Biological Institutional Scientific Collection (NBISC)



Collection of non-human specimens and space microbial culture

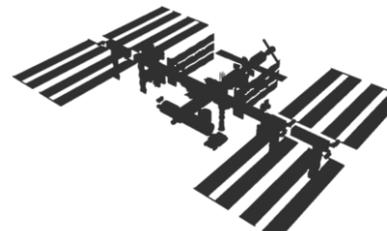


Open Source Science Programs — Available Globally

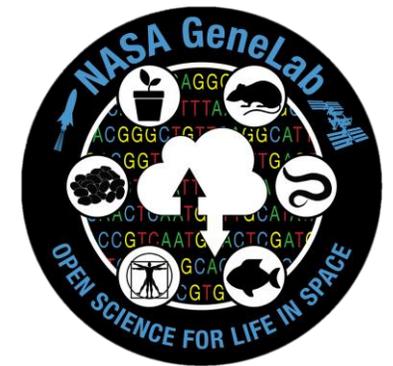
Ames Life Sciences Data Archive (ALSDA) 1994



Collection and curation of mission, project, and imaging data



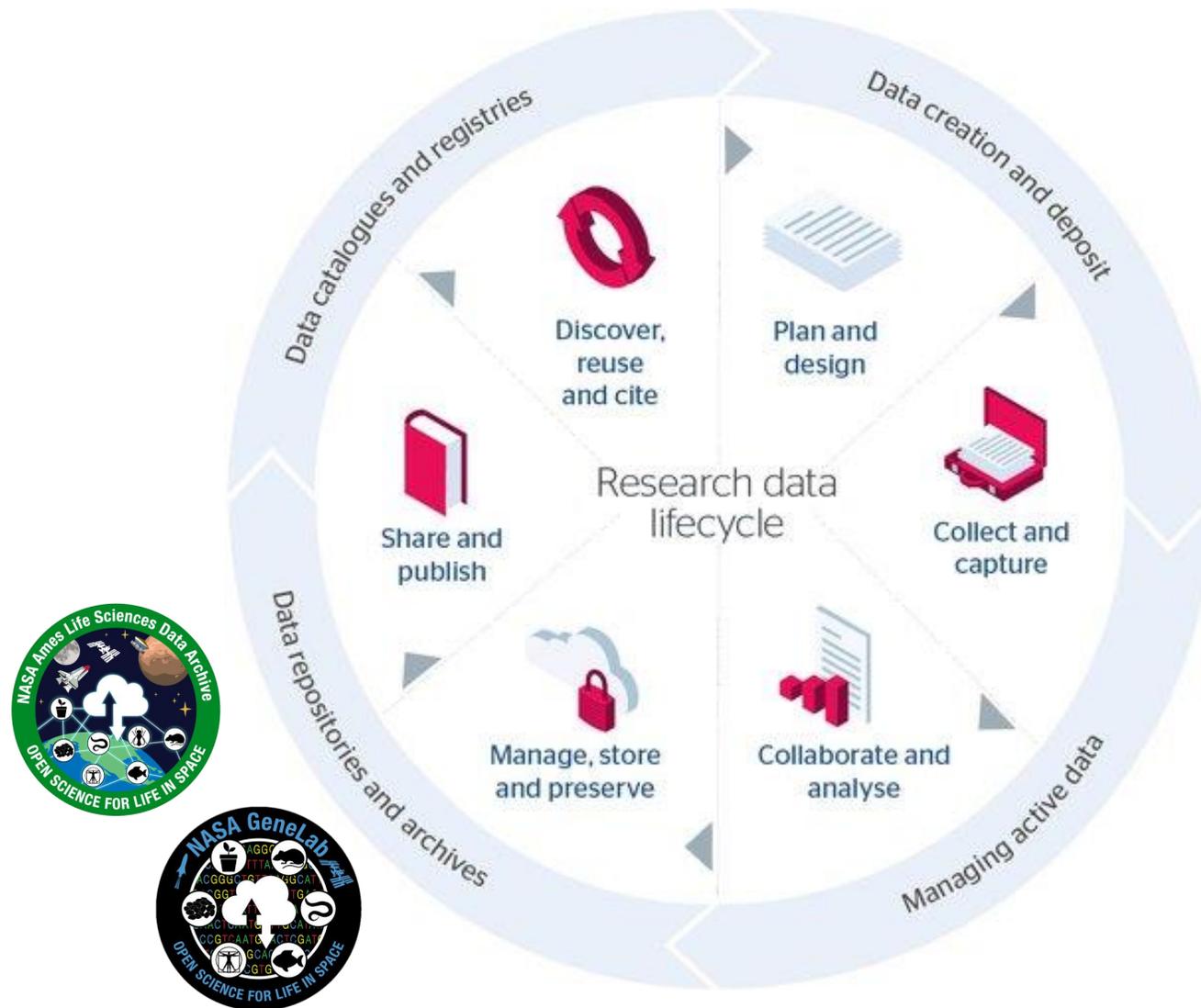
NASA GeneLab (GL) 2014



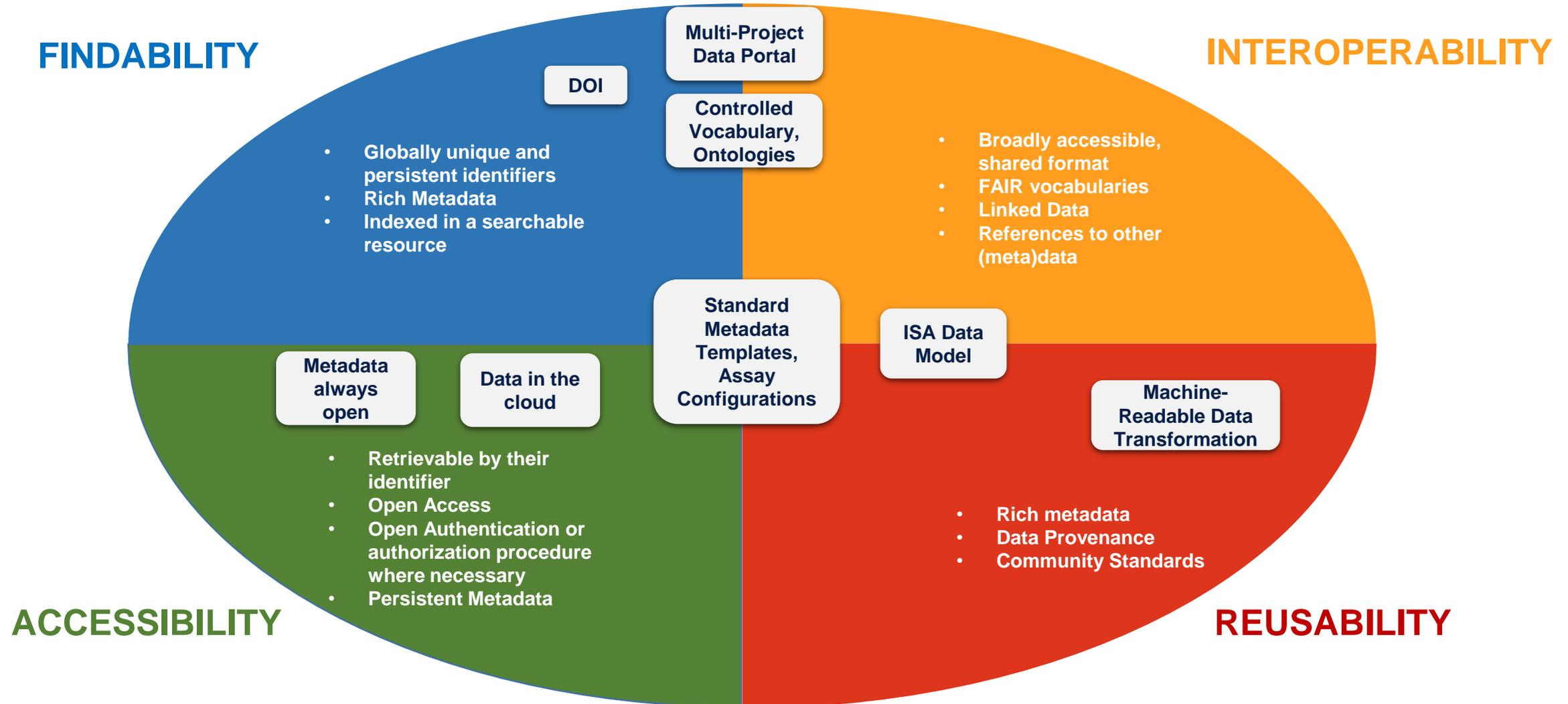
Collection and curation of omics data



Research Data Life Cycle



FAIR Progress: GeneLab + ALSDA



Centralizing information of different types of data

osdr.nasa.gov/bio



Open Science Projects

Open Science Projects primary goals aim to increase collaborative scientific data sharing, analysis and more rapid scientific advancement.

GeneLab

GeneLab, an open science multi-omics repository, covering transcriptomics, metagenomics, epigenomics, proteomics, and metabolomics. Studies comprise of data from model organisms including microbes, plants, fruit flies, rodents and humans.

[Learn more GeneLab](#)

BSP

The NASA Space Biology Biospecimen Sharing Program (BSP) collects biospecimens to maximize the scientific return from biological spaceflight and associated ground investigations and to encourage and broaden participation from the scientific community in space biology-related research.

[Learn more about BSP](#)

ALSDA

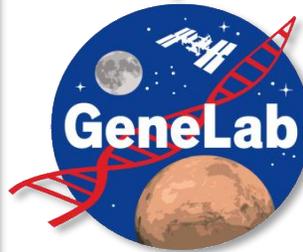
Ames Life Sciences Data Archive (ALSDA) collects, curates, and makes available space-relevant higher-order phenotypic datasets. Datasets that enable scientists to perform retrospective analysis across missions, experiments, life science disciplines, research subjects, and species.

[Learn more about ALSDA](#)

NBISC

NASA Biological Institutional Scientific Collection (NBISC) is a biorepository of non-human samples collected from NASA-funded spaceflight investigations and correlative ground studies. The purpose of NBISC is to receive, store, document, preserve, and make the collection available to the scientific community.

[Learn more about NBISC](#)



General Search Filters

Data Source

- GeneLab
- ALSDA
- NIH GEO
- EBI PRIDE
- ANL MG-RAST

Data Type

- Study
- Experiment
- Subject
- Biospecimen
- Payload

Show more ▾

Study Search Filters

Project Type

Common online search

Open Science Data Repository Search

Search Datasets

Sort By: Release Date ▾

Items per page: 25 ▾ 1 - 25 of 448 |< < > >|

Study OSD-385

Persistence of Escherichia coli in the microbiomes of red Romaine lettuce (*Lactuca sativa* cv. 'Outredgeous')- does seed sanitization matter?

Organisms	Factors	Assay Types	Release Date	Description
Microbiota	Treatment Seed Sanitization Tissue	Amplicon Sequencing	19-Apr-2024	Seed sanitization via chemical processes removes/reduces microbes from the external surfaces of the seed and thereby could have an impact on the plants health or productivity. To determine the impact ...

Highlights: *cgene*

Study OSD-386

Persistence of Escherichia coli in the microbiomes of mizuna mustard (*Brassica rapa* var. *japonica*) - does seed sanitization matter?

Organisms	Factors	Assay Types	Release Date	Description
	Treatment Seed Sanitization Organism Part	Amplicon Sequencing	05-Apr-2024	Seed sanitization via chemical processes removes/reduces microbes from the external surfaces of the seed and thereby could have an impact on the plants' health or productivity. To determine the impact ...

Mission Telemetry Data

Ascent Flight

Return Ground Control

Relative Humidity, Temperature, CO2, O2, Airflows, Acceleration, Radiation, Acoustics, etc.



Breakdown of a Reusable Dataset: Architecture, Curation, FAIRness

OSDR Meta/Data Model

Leverages/inspired by "ISAtab"

investigation

- Contacts, description, study factors, provenance

sample
n

- Table w/individual subject-sample parameters, study design, independent variables, sample collection metadata

assay
n

- Table w/individual subject-samples by assay with device name, settings, targets, parameters, reagents, **standards** SME-driven



data

- Various formats to maximize reuse, machine-readable
- Tabular, text, images, video
- Molecular-omics, physiological-phenotypic-behavior-imaging
- Raw, submitted, processed, transformed for reusability

Open Science Dataset Example



257.05 KB

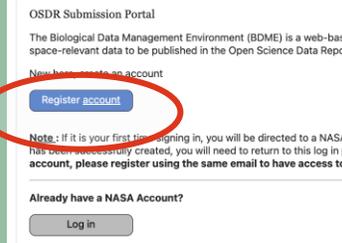
OSD-488 Version 1
Characterizing SERCA of Spaceflight from R

Study

Submitted Date: 28-Mar-2022
Initial Release Date: 20-Jan-2023

ALSDA ID: LSDS-13
DOI: 10.26030/3nve-tk61

Cite this Study

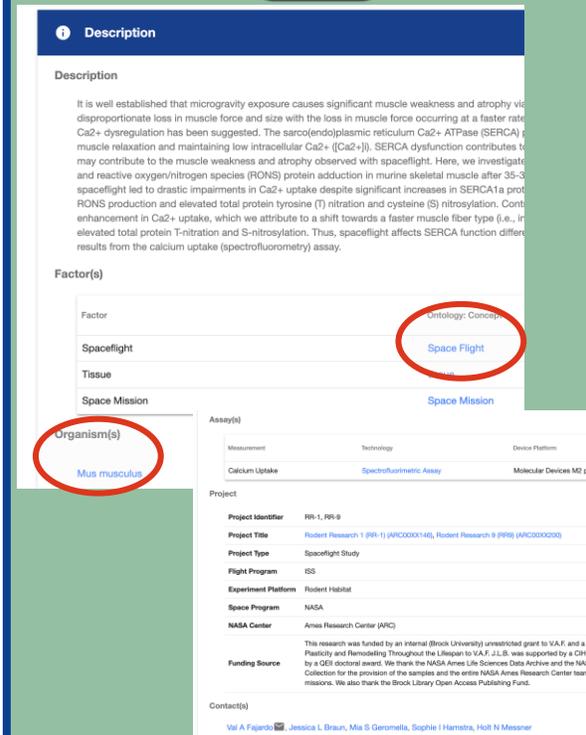


- Global Unique Identifiers



- Secure/Integrated Credentials

investigation



- Metadata Normalization
 - ie., mus musculus
 - ie., Space Flight

Breakdown of a Reusable Dataset: Architecture, Curation, FAIRness

sample
n

- Individual Subject/Sample Independent Variable Metadata
- Study Design Metadata

Samples

Source Name	Sample Name	Factor Value: Spaceflight	Factor Value: Tibialis Anterior	Characteristics: sex	Factor Value: Space Mission	Character: Launch
RRR_GC11	GC11_1a	Ground Control	tibialis anterior	male	SpaceX-12 (RRR)	10 week
RRR_GC12	GC12_1a	Ground Control	tibialis anterior	male	SpaceX-12 (RRR)	10 week
RRR_GC13	GC13_1a	Ground Control	tibialis anterior	male	SpaceX-12 (RRR)	10 week
RRR_GC14	GC14_1a	Ground Control	tibialis anterior	male	SpaceX-12 (RRR)	10 week
RRR_GC15	GC15_1a	Ground				
RRR_GC16	GC16_1a	Ground				
RRR_GC17	GC17_1a	Ground				
RRR_GC18	GC18_1a	Ground				
RRR_GC19	GC19_1a	Ground				
RRR_GC20	GC20_1a	Ground				

Interoperable

- Metadata Normalization
 - i.e. muscle names / time
- Tibialis anterior

investigation
n

sample
n

BioPortal

OBO Foundry

Ontobee

Find an ontology

Start typing ontology name, then choose from list

[Browse Ontologies](#)

F

A

I

R

- Rich Metadata
- Metadata Schemas
- Community Standards

Interoperable

- Community Standards
- Data Provenance

assay
n

- Dependent Variable Metadata
- How assay was conducted
- Specs of device, settings, software, processing details, etc

Assays

Assay Name: Calcium Update

Technology Platform: Molecular Devices M2 plate reader

Technology Type: Microplate Reader

Specifications: Assay

Sample Name	Assay Name	Assay Type	Parameter Value: Distance Measurement	Parameter Value: Time	Parameter Value: Temperature	Assay Name	Raw Data File	Parameter Value: Date
GC11_1a	365 nanometer	485 nanometer	48 min at 20s Interval	37 degree Celsius	SpectraMax M2	calcium update	Not Available	LSOS-13, calcium-update, final
GC12_1a	365 nanometer	485 nanometer	48 min at 20s Interval	37 degree Celsius	SpectraMax M2	calcium update	Not Available	LSOS-13, calcium-update, final
GC13_1a	365 nanometer	485 nanometer	48 min at 20s Interval	37 degree Celsius	SpectraMax M2	calcium update	Not Available	LSOS-13, calcium-update, final
GC14_1a	365 nanometer	485 nanometer	48 min at 20s Interval	37 degree Celsius	SpectraMax M2	calcium update	Not Available	LSOS-13, calcium-update, final

Interoperable

- Metadata Normalization
 - i.e., OCT (optical coherence tomography)
 - OCT (media/sectioning; optimum cutting temperature)

data

- Raw, Processed; Submitted, Transformed
- Tabular, text, imaging, video
- AWG standardized nomenclature
- Maximally human & machine-readable

Files

Study Files

Search Files

- OSD-488
- Calcium Update
- Processed Data Files
- LSOS-13, calcium-update, final
- LSOS-13, calcium-update, final
- Original Submitted Results Data Files
- Study Metadata Files

Version History

Selected Version

Version 1

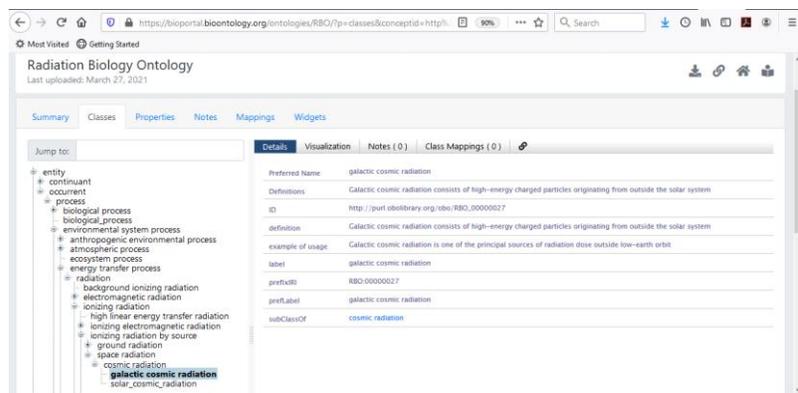
Show/Hide All Version Information

Reusable

- Community Standards
- Data Provenance

Community Standards - FAIR

Radiation Biology Ontology (RBO) is an ontology for the effects of radiation on biota in terrestrial and space environments.



Launched and maintained by members of OSDR

Paul Schofield, University of Cambridge

Luke Slater, University of Birmingham

Jack Miller, Lawrence Berkeley National Laboratory

Daniel Berrios, NASA Ames Research Center

Sylvain V. Costes, NASA Ames Research Center

Open Science Analysis Working Groups



Animal, Multi-Omics, Microbe, Plant, ALSDA, AI/ML

Consist of **500+ scientists** from multiple space agencies, international institutions, and industry. Scientists meet monthly with each group to **provide feedback, develop standards, and analyze data.**

Curation Standards

Use current Minimum Information Standards for Assays

- MIxS
- MIAPE
- MIAME

Develop templates for Assays using our scientific community and references

Configuration Name ie., measurement then technology	Status
Behavior (Elevated Plus Maze)	Active
Flow Cytometry (Flow Cytometry)	Active
Behavior (Novel Object Recognition)	Active
Calcium Uptake (Spectrofluorimetry)	Active
Protein Quantification (Western Blot)	Active
Molecular Cellular Imaging (Light/Fluorescence Microscopy)	Active

OSDR: Access & Explore Data

CONTRIBUTE

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All RDSA Studies Experiments

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1-385 : Persistence of *Escherichia coli* in the microbiomes of red Romaine lettuce (*Lactuca sativa* cv. 'Outredgeous')- does seed sanitization matter?

Public Release Date: 18-Apr-2024

Lead Investigator: ckhodada

SUMMARY

Seed sanitization via chemical processes removes/reduces microbes from the external surfaces of the seed and thereby could have an impact on the plants, health or productivity. To determine the impact of seed sanitization on the plants, microbiome and pathogen persistence, sanitized and unsanitized seeds from two leafy green crops, red Romaine lettuce (*Lactuca sativa* cv. 'Outredgeous'), and Mizuna mustard (*Brassica rapa* var. japonica) were exposed to *Escherichia coli* and grown in controlled environment growth chambers simulating environmental conditions aboard the International Space Station. Plants were harvested at four intervals from 7 days post-germination to maturity. The bacterial communities of leaf and root were investigated using the 16S rRNA sequencing while quantitative polymerase chain reaction (qPCR) and heterotrophic plate counts were used to reveal the persistence of *E. coli*. *E. coli* persisted for longer periods of time in plants from sanitized versus unsanitized seeds and was identified in root tissue more frequently than in leaf tissue. 16S rRNA sequencing showed dynamic changes in the abundance of members of the phylum Proteobacteria, Firmicutes, and Bacteroidetes in leaf and root samples of both leafy crops. We observed minimal changes in the microbial diversity of lettuce or Mizuna leaf tissue with time or between sanitized and unsanitized seeds. Beta-diversity showed that time had more of an influence on all samples versus the *E. coli* treatment. Our results indicated that the seed surface sanitization a requirement for sending seeds to space influences the microbiome. Insight into the changes in the crop microbiomes could lead to healthier plants and safer food supplementation.

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DISCOVER

Open Science Data Repository Search

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General Search Filters

Data Source: GeneLab, ALL GEO, NIH GEO, EBI PRIDE, ANL SDSC-BEST

Data Type: Study, Experiment, Subject, Bioprescreen, Payload

Study Search Filters

Project Type: Ground, Spaceflight, High Altitude

Assay Type: Amplicon Sequencing Assay, Disruptive Sequencing, Clust-Seq, Behavior (Dist), Get Electrophoresis

OSD-385: Persistence of *Escherichia coli* in the microbiomes of red Romaine lettuce (*Lactuca sativa* cv. 'Outredgeous')- does seed sanitization matter?

OSD-385: Microbiota, Treatment: Seed Sanitization, Assay Types: Amplicon Sequencing, Release Date: 18-Apr-2024, Description: Seed sanitization via chemical processes removes/reduces microbes from the external surfaces of the seed and thereby could have an impact on the plants, health or productivity. To determine the impact...

OSD-580: Transcriptional profiling of heart tissue from mice flown on the RRRM-2 mission

OSD-580: Mus musculus, Spaceflight: Euthanasia Location, Assay Types: transcription profiling, Release Date: 03-Jan-2024, Description: In the Rodent Research Reference Mission (RRRM-2), forty female C57BL/6J mice were flown on the International Space Station to assess differences in outcomes due to age, twenty 12-week old and ten 6-week old.

OSD-576: Transcriptional profiling of tibialis anterior muscle from mice flown on the RR-23 mission

OSD-576: Mus musculus, Spaceflight, Assay Types: transcription profiling, Release Date: 12-Dec-2023, Description: The objective of the Rodent Research 23 mission (RR-23) was to better understand the effects of spaceflight on the eyes, specifically on the structure and function of the arteries, veins, and lymphatics.

OSD-577: Ionizing radiation induces transgenerational effects of DNA methylation in zebrafish

OSD-577: Organisms, Factors, Assay Types, Release Date, Description: Ionizing radiation is known to cause DNA damage, but the mechanisms...



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Filter files by name

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GLDS-104 4 months ago

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Save your volcano plot
ggsave(file.path(DGE_plots, 'GLDS-104_volcano_DGE.png'), width = 6.5, height = 8.5, dpi = 300)

FLT versus GC
EnhancedVolcano

● N5 ● Log2FC ● Adj. p-value ● Adj. p-value & Log2

-Log10 P

Log2 fold change

total = 21880 variables

Gm5532, Cntfr, Ucn1, Lrrc5, Cdk1, Fam51a, Arrb2, Dhx9, Ttk1, Wnt9b, Krt17

Simple 0 4 R [conda env:gl4u-r] | Idle Mem: 4.09 / 4.00 GB Mode: Command Ln 2, Col 25 RNAseq_DGE_JN_06-2022.ipynb



EXPLORE

Open Science for Life in Space

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Number of studies: 294

Filter

Assay technology type

- DNA microarray: 149
- RNA Sequencing (RNA-Seq): 134
- nucleotide sequencing: 75
- mass spectrometry: 35
- microarray: 9

Organism

- rodent: 143
- bacteria: 97
- fungus: 79
- human: 63
- plant: 60

Tissue

- root: 22
- liver: 9
- leaf: 8
- whole organism: 6
- spleen: 4

Factor

- spaceflight: 191
- ionizing radiation: 107
- time: 69

Factor

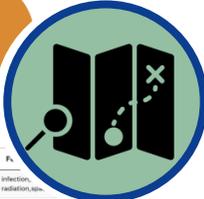
Assay

Organism

Tissue

GLDS-1	Title	Assay	Organism	Tissue	
GLDS-1	Expression data from drosophila melanogaster	DNA microarray	Drosophila melanogaster	whole organism	infection, radiation, spaceflight
GLDS-4	Microarray Analysis of Space-flown Murine Thymus Tissue	DNA microarray	Mus musculus	thymus	spaceflight
GLDS-19	Transcription profiling of rat to study the effect of hindlimb unloading on healing of medial collateral ligaments 3 weeks after injury	DNA microarray	Rattus norvegicus	Medial collateral ligament	hindlimb unloading, treatment, spaceflight
GLDS-21	Effects of spaceflight on murine skeletal muscle gene expression	DNA microarray	Mus musculus	call muscle, gastrocnemius	spaceflight
GLDS-25	STS-135 Liver Transcriptomics	DNA microarray	Mus musculus	liver	spaceflight
GLDS-26	Micronomes of the Dust Particles Collected from the International Space Station and Spacecraft Assembly Facilities	amplicon sequencing assay	cellular organisms	Cells	sample location, spaceflight
GLDS-27	Transcription of the spaceflight transcriptome of four commonly	RNA Sequencing (RNA-Seq)	Arabidopsis thaliana	Seedlings	ecovise, spaceflight

Visualize Study



Re-use of Data and Enabling New Discoveries

59 (10+ by AWGs) publications using data available in OSDR.

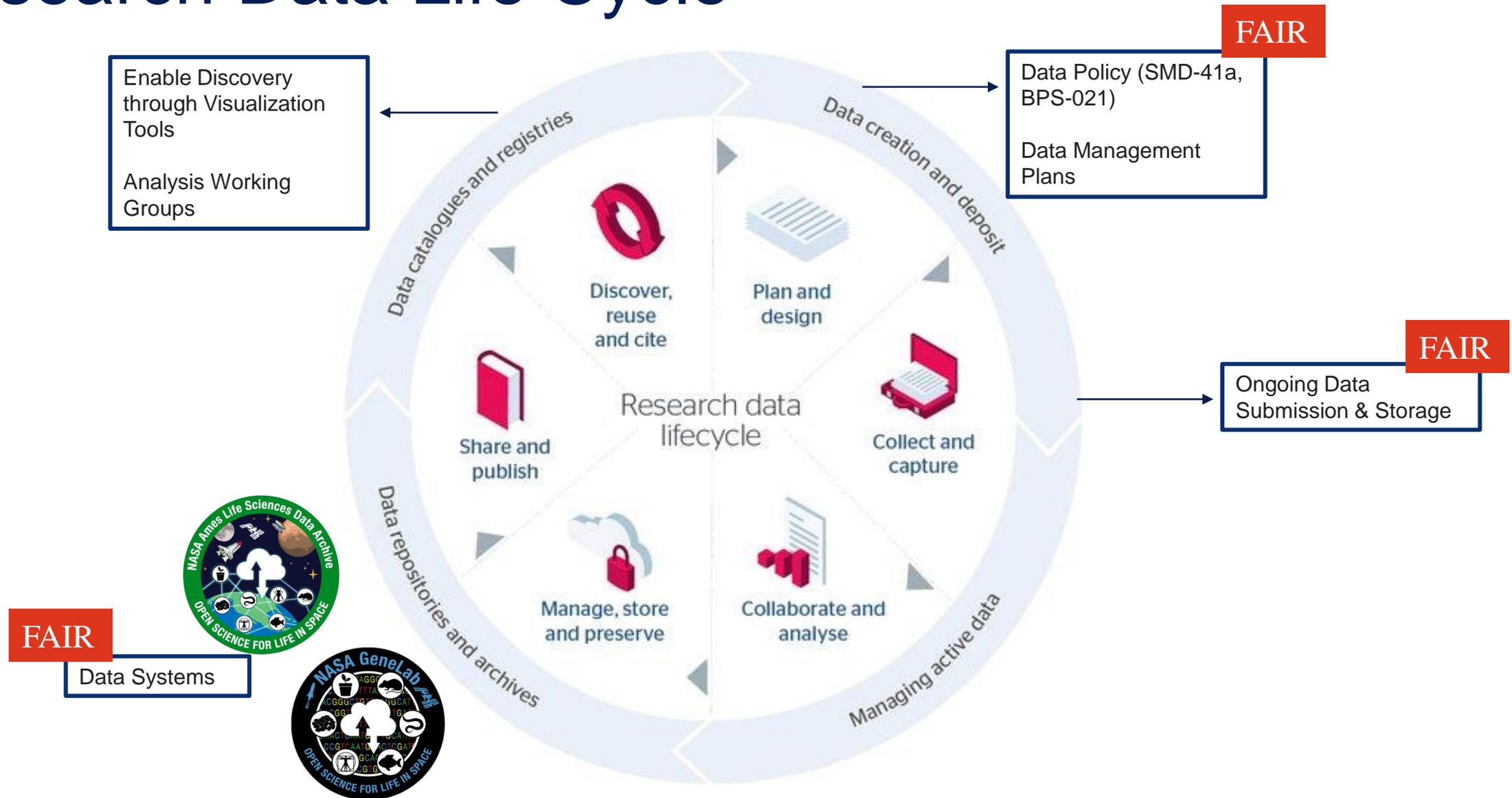


FAIR Assessment

		● Pass	◐ Partial pass	○ Fail		
FAIR Principle	Metric	GEO ⁴	ENA ⁷	MG-RAST ⁶	Metabolights ⁸	GLDS
F1. (meta)data are assigned globally unique and persistent identifier	FM-F1A	●	●	◐	●	●
F1. (meta)data are assigned globally unique and persistent identifier	FM-F1B	●	●	○	●	●
F2. data are described with rich metadata (defined by R1 below)	FM-F2	●	●	●	●	●
F3. metadata clearly/explicitly include identifier of data it describes	FM-F3	●	●	●	●	●
F4. (meta)data are registered or indexed in a searchable resource	FM-F4	●	●	○	◐	●
A1. (meta)data are retrievable by identifier using a standardized communications protocol		N/A				
A1.1 the protocol is open, free, and universally implementable	FM-A1.1	●	●	●	●	●
A1.2 the protocol allows for an authentication and authorization procedure, where necessary	FM-A1.2	●	●	●	●	●
A2. metadata are accessible, even when data are no longer available	FM-A2	●	●	○	○	●
I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.	FM-I1	○	○	○	◐	◐
I2. (meta)data use vocabularies that follow FAIR principles	FM-I2	○	○	○	◐	◐
I3. (meta)data include qualified references to other (meta)data	FM-I3	○	○	○	○	○
R1. meta(data) are richly described with a plurality of accurate and relevant attributes		N/A				
R1.1. (meta)data released with clear, accessible data usage license	FM-R1.1	●	●	●	●	●
R1.2. (meta)data are associated with detailed provenance	FM-R1.2	●	●	◐	●	●
R1.3. (meta)data meet domain-relevant community standards	FM-R1.3	●	●	○	●	●
Overall FAIRness Score		11	11	6	10.5	12

The FAIR principles, corresponding draft FAIRness metrics, and semi-quantitative FAIRness ratings for select omics data systems. Metrics were those developed by the GO FAIR Metrics²³ group

Research Data Life Cycle



What's Next

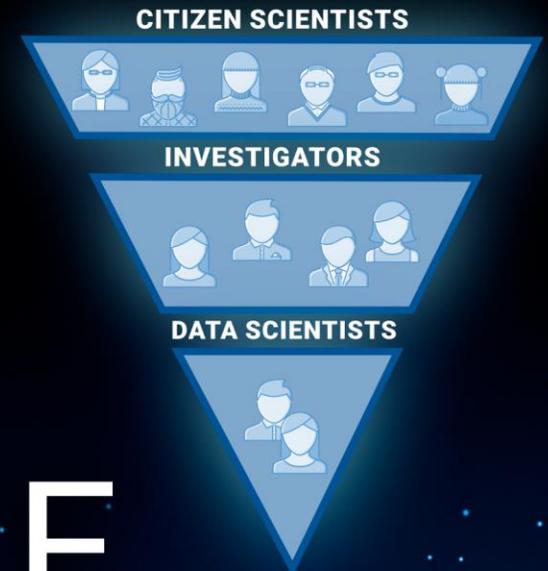
- We will be using the information and feedback from discussions at this webinar and upcoming workshops to select the appropriate tool(s) to evaluate FAIRness.
- Continue to enhance our data systems to ensure (meta)data is FAIR
- Continue working with the scientific community on FAIR
- Should we evaluate other principles such as TRUST? Certification for repositories such as CoreTrustSeal?
- Continue to communicate budget needs to maintain and enhance FAIR

THANK YOU!

TISSUE REPOSITORY



SCIENTIFIC COMMUNITY



OPEN SCIENCE

DATA REPOSITORY



GENELAB
OMICS

+

ALSDA
PHENOTYPIC



Open Science for Life in Space projects are funded by the Biological and Physical Sciences Division